Shell/TNC: coastal pipeline erosion control using oyster reefs

**Source/organisation:** Shell Pipeline Company LP

**Scale:** Approximately one mile of shoreline in total, the pilot project will be designed with the intention to be replicated at other similar sites

**Key partner(s):** Shell Global Solutions International, The Nature Conservancy

**Project phase:** Feasibility study ongoing; final decision to proceed or not will be taken mid-2013, pending approval/acceptance of the design

**Geographical location:** Ship Shoal, Louisiana, USA

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**Project overview**
Attenuation of soil and marshland erosion around oil and gas pipelines located on or near shorelines is a chronic concern for Shell and other commercial operators in the Gulf of Mexico. Erosion is caused by waves from marine traffic, tidal currents, and acute weather events like hurricanes. Maintaining these pipelines currently requires an intensive and expensive monitoring and maintenance system. The traditional gray approach uses hardened structures that armour and stabilise the shoreline; rock reinforcement, wood and metal structures, sand or cement bags to slow erosion, particularly in high energy environments.

The main drawbacks of this existing system from the company’s perspective are the costs and risks related to maintenance activities taking place around these hardened man-made structures. There is the ongoing risk of pipeline damages related to frequent boat traffic, as well as the loss of intertidal habitat.

To lower these costs and the overall risks to the pipeline, Shell and The Nature Conservancy have been exploring shoreline erosion control methods using natural infrastructure to further attenuate erosion from waves. The
final project may encompass a hybrid solution using a combination of green and gray infrastructure.

**Technology Maturity**
There is empirical evidence that supports that green infrastructure can be an effective measure against shoreline erosion and wave energy. The innovation lies in applying the concept of green infrastructure to more effectively protect pipelines from coastal erosion while offering multiple environmental and social benefits.

**Investment/Costs/Time**
A primary objective of this pilot project is to better understand the relative costs of using these methods and test the hypotheses that natural infrastructure is more cost-effective than made-made infrastructure. Historically, green infrastructure installations, such as oyster reef breakwaters, have cost approximately $1 million per mile versus $1.5 to $3 million per mile to install traditional gray rock barriers, though this is highly variable. GI solutions are expected to require lower initial capital costs and lower maintenance costs due to being inherently self-sustaining.

**Project Management Considerations**
The approach taken thus far has been to hold workshops and meetings to design this project as a joint effort between Shell Global Solutions International, Shell Pipeline Company LP and experts from The Nature Conservancy. The team organised a field visit and gathered location-specific data as part of the bid process to generate conceptual proposals for the Ship Shoal pipeline. Due to the importance of pipeline integrity, an internal risk analysis will be performed on the proposed solutions.

Selection criteria for the proposals are: installation/maintenance cost savings, efficiency in sediment accumulation for stabilisation, innovative edge and the delivery of ecosystem services.

**Benefits**
- Creates a natural buffer to protect the shoreline and pipeline from erosion.
- Can preserve and/or create habitat for benthic, estuarine, shallow water, and intertidal organisms.
- Increases stability for pipelines.
- Improves local water quality.
- Lowers installation and maintenance costs compared to gray solutions.
- Offers potential for local job creation.
– Creates land behind the natural defences (open water to marsh; marsh to land).
– Has potential for self-repairing (fixes cracks developed from potential storm) and self-organising structure (oyster bed builds up with sea level rise).

**RISKS/CHALLENGES**
– It is important to understand the business case (green vs gray).
– Shell’s comfort level with long-term liability issues (public access to a newly created oyster bed is a concern).
– GI solutions will need to comply with company and industry standards and requirements.
– These novel approaches require receptiveness of both internal and external stakeholders.
– There may be a need to train new contractors who may not be familiar with designing and installing natural infrastructure.
– The greatest concern may be related to social stresses such as pressure from oyster fishermen who could harvest and potentially inhibit natural growth and effectiveness.

**RESILIENCE ASPECTS**
– GI solutions have the dynamic capacity to repair themselves and adapt to evolving chronic and acute stressors. For example, in response to rising water levels due to climate change, an oyster reef will grow to match the new water levels, unlike any gray infrastructure.
– GI solutions offer multi-functional benefits, such as oyster beds providing erosion control and other ecosystem services.

**KEY LEARNING**
– The keys to success for these kinds of methods will be finding the appropriate project scale, managing any regulatory constraints, proving long-term benefits, proving effectiveness at sediment accumulation and wave attenuation thereby protecting the pipeline, and creating a replicable product and process.
– A successful pilot should resolve most of the institutional, regulatory and financial concerns.
– Key anticipated lessons relate to testing the hypotheses that green infrastructure can be a superior alternative to gray infrastructure in protecting pipelines in the Gulf of Mexico, and better understanding under what circumstances green infrastructure and/or a hybrid combination of green/gray infrastructure is a cost-effective investment.